

Remarks

This Preliminary Amendment cancels without prejudice original claims 1 to 10 in the underlying PCT Application No. PCT/DE2004/000615. This Preliminary Amendment adds new claims 11-30. The new claims, inter alia, conform the claims to United States Patent and Trademark Office rules and do not add new matter to the application

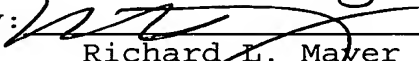
In accordance with 37 C.F.R. § 1.125(b), the Substitute Specification (including the Abstract, but without the claims) contains no new matter. The amendments reflected in the Substitute Specification (including Abstract) are to conform the Specification and Abstract to U.S. Patent and Trademark Office rules or to correct informalities. As required by 37 C.F.R. § 1.121(b)(3)(ii) and § 1.125(c), a Marked Up Version Of The Substitute Specification comparing the Specification of record and the Substitute Specification also accompanies this Preliminary Amendment. Approval and entry of the Substitute Specification (including Abstract) are respectfully requested.

The underlying PCT Application No. PCT/DE2004/000615 includes an International Search Report, dated February 22, 2005, a copy of which is included. The Search Report includes a list of documents that were considered by the Examiner in the underlying PCT application.

Applicants assert that the subject matter of the present application is new, non-obvious, and useful. Prompt consideration and allowance of the application are respectfully requested.

Respectfully Submitted,  
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Dated: 7/1/05

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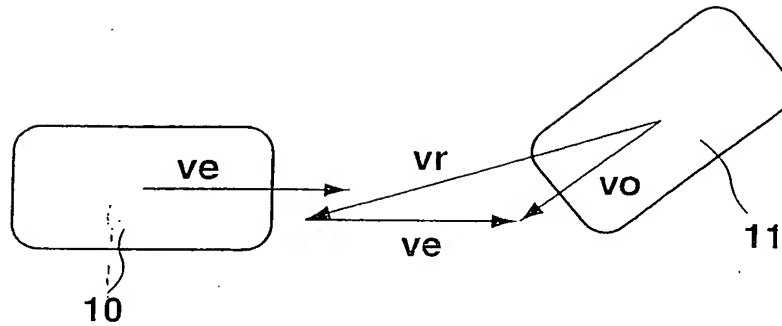


Fig. 1

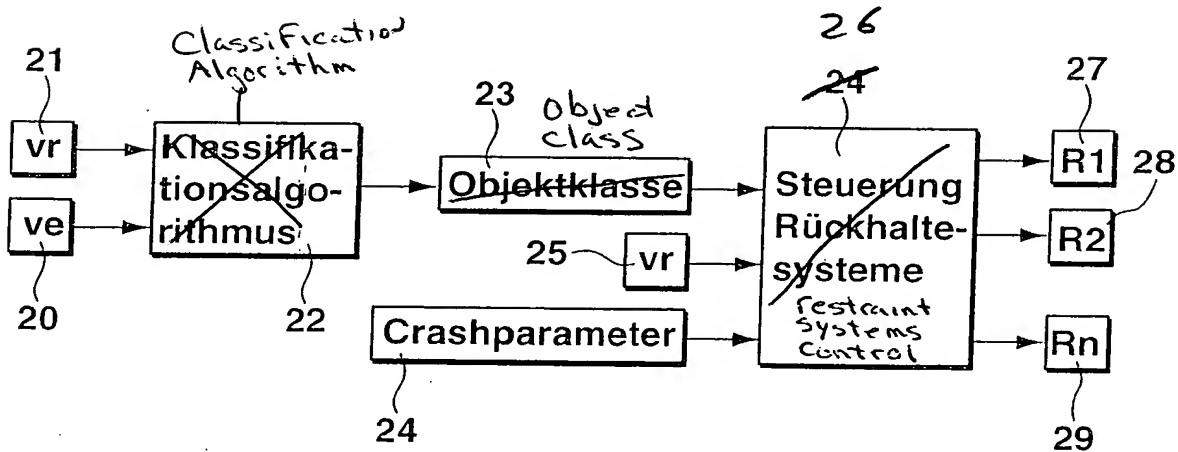
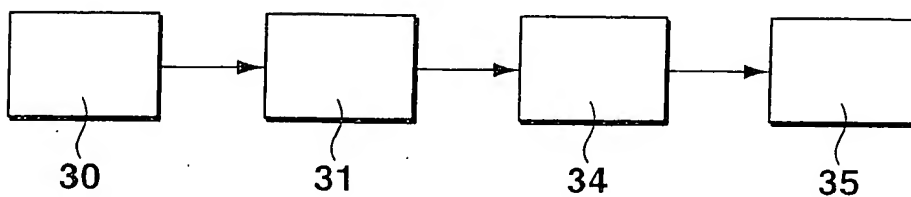


Fig. 2



DEVICE FOR CLASSIFYING AT LEAST ONE OBJECT WITH THE AID OF AN  
ENVIRONMENTAL SENSOR SYSTEM

Background Information

The present invention ~~starts out from~~ relates to a device for  
classifying at least one object with the aid of an  
5 environmental sensor system ~~according to the definition of~~  
~~species in the independent claim.~~

A camera-based precrash detection system is known from DE 100  
25 678 A1. In this context, collision counterparts are  
10 classified with the intention of providing reliable  
standardization. The classification is carried out on the  
basis of the relative velocity of these objects.

Summary of the Invention

15 The device of the present invention for classifying at least  
one object, ~~having features of the independent claim,~~ has the  
advantage over the related art that the object is now  
classified on the basis of its velocity and the acceleration.

20 In particular, the acceleration information also allows  
objects to be classified more reliably. For example, a first  
discriminating criterion is the exclusion of objects securely  
anchored to the ground, such as poles and walls, when the  
25 object to be classified can be assigned a velocity other than  
zero. If desired, the position of the object (e.g. on the  
roadway, next to the roadway) may be used to check the  
plausibility of the classification. Different classes of  
objects (such as, on one hand, vehicles and, on the other  
30 hand, pedestrians) may also be distinguished on the basis of

their movement patterns, i.e. the specific velocity and acceleration characteristic.

It is at least possible to divide the objects into static and moving or accelerating objects. When assigning a crash object to the class of moving objects, this classification may be used for controlling restraint systems in a more precise manner.

#### Brief Description of the Drawing

Exemplary embodiments, of the present invention are shown in the drawing and are explained in detail in the following description.

Figure 1 shows a typical scene of a vehicle and an object, and Figure 2 shows a block diagram of the device according to the present invention.

~~Advantageous improvements of the device, indicated in the independent claim, for classifying at least one object are rendered possible by the measures and further refinements specified in the dependent claims.~~

#### Detailed Description of the Invention

It is particularly advantageous that the acceleration of the object is determined as a function of the reference acceleration of the observer. However, the acceleration may also or additionally be determined from the time characteristic of the reference velocity and the object velocity. In this context, the reference velocity means the velocity of the observer, i.e. that of the reference vehicle which is equipped with the classification device. This reference velocity may be determined, for example, on the basis of wheel velocities, the ABS system, or the tachometer.

The object velocity is the velocity of the object. As an alternative, the velocity may also be determined on the basis of a curve of location information versus time.

- 5 In addition to or instead of a radar, ultrasonic, and/or video sensor system, the environmental sensor system may also have a photonic mixer device and/or a LIDAR system, where, in addition to the conventional radar system that uses microwaves, the LIDAR system uses laser.

10

The environmental sensor system may advantageously have a photonic mixer device, as well. In this context, the so-called time-of-flight measurement is used, which allows distance information in the image plane of an imaging system.

- 15 At this point, reference is made to DE 197 04 496 A1, which describes such a photonic mixer device.

As a function of the classification, the driver may also be informed when, for example, a critical situation involving a high accident risk is present. This information may occur optically, acoustically, and/or haptically. In particular, the tightening of the reversible seatbelt tensioner is used as haptic information.

20

- 25 Finally, it is also advantageous that a restraint system is controlled as a function of this classification. This is particularly advantageous for the control of reversible restraining devices, as well.

30 ~~Brief Description of the Drawing~~

~~Exemplary embodiments of the present invention are shown in the drawing and are explained in detail in the following description.~~

35

~~Figure 1 shows a typical scene of a vehicle and an object, and Figure 2 shows a block diagram of the device according to the present invention.~~

## Description

With the aid of suitable sensor technology, such as radar,  
5 ultrasonic, LIDAR, or video technology, it is possible to  
measure distances and relative velocities between objects and  
the radar sensor. In this connection, such information  
regarding the impact time and velocity may be ascertained in  
precrash systems, in order to control restraining devices.

10 In certain measuring systems, such as the radar system, which  
only use the distance information and do not provide three-  
dimensional spatial resolution, it is not possible to classify  
objects, since, for example, only the total radar cross-  
15 section is available as a property characteristic of the  
object.

According to the present invention, an object is now  
classified on the basis of its velocity characteristic. This  
20 means that the characteristic curve of the velocity is  
determined from the velocity of the object and its  
acceleration. Both parameters, the velocity and the  
acceleration, define the object, which means that restraining  
devices may then be precisely controlled as a function of the  
25 classification.

The measuring system determines the relative velocity between  
the crash object and the reference vehicle. The velocity of  
the object may be calculated from this relative velocity and  
30 the available velocity of the reference vehicle, which may be  
evaluated, e.g. via CAN. Then, the acceleration of the object  
may also be estimated from the history of the two data and the  
brake condition of the reference vehicle. Using the velocity  
and the acceleration of the object, a classification is  
35 undertaken by an object-classification algorithm. If an  
object belongs to the class of moving and accelerating  
objects, this information may be used in the algorithm for  
controlling restraint systems, since it is highly probable

that the object is not a pole or a rigid wall. The restraint systems may then be controlled in the algorithm in accordance with the object class and further crash parameters, e.g. acceleration signals and the relative velocity.

5

Figure 1 shows such a scene, in which the device of the present invention is used. Reference vehicle 10 has a reference velocity  $VE$ , while an object 11, a vehicle monitored by the precrash sensor system of vehicle 10, has velocity  $VO$ .

10 Relative velocity  $VR$  results from the vectorial subtraction of reference velocity  $VE$  and velocity  $VO$ . Velocity  $VR$  may be ascertained by a precrash sensor system. The accelerating behavior of vehicle 11 may be determined, for example, from the time characteristic of relative velocity  $VR$ . Velocity  $VO$ ,  
15 which is determined using relative velocity  $VR$  and reference velocity  $VE$ , and the acceleration of vehicle 11, result in a classification of vehicle 11. Reference velocity  $VE$  is ascertained, for example, via the wheel velocities.

20 Figure 2 clarifies the device of the present invention, using a block diagram. In block 21, relative velocity  $VR$  is ascertained by a precrash sensor system. In block 20, reference velocity  $VE$  is determined as shown above, e.g. using the wheel velocities and/or a tachometer. A classification  
25 algorithm 22, which is computed on a processor of the control unit, e.g. the airbag control unit, determines the object velocity and its acceleration from the time characteristic of velocities  $VR$  and  $VE$ . Algorithm 22 classifies vehicle 11 from these velocities and the acceleration. It then assigns, to  
30 object 11, predefined object classes which are defined by velocity  $VO$  and the acceleration. In block 26, the restraining devices are triggered as a function of relative velocity 25 and further crash parameters, such as the decelerations that are generated in block 24. In this case,  
35 the restraining devices may be, e.g. restraining devices  $R1$  a seat-belt tensioner 27,  $R2$  a front airbag 28, and  $RN$  a front-passenger-side airbag 29.



Figure 3 explains, in an additional block diagram, the individual components of the device according to the present invention. A precrash sensor system 30 determines relative velocity VR of object 11. In processor 31, which receives the signal of precrash sensor system 30, velocity VO of object 11 is then determined from the signal, using the reference velocity of the vehicle on which precrash sensor system 30 is located. Reference velocity VE is ascertained, e.g. using a wheel-velocity measurement or the tachometer. This information is contained, for example, on the CAN bus. The acceleration behavior of object 11 is determined from the time characteristic of velocity VO and velocity VE. The object classification is obtained from this, i.e. the class of the object is determined by the acceleration and velocity VO. This object class is then transmitted to a control unit 34 for restraint systems. As a function of the object class and these further parameters, control unit 34, which is connected to other vehicle components and sensors via connections not shown here, determines the activation of restraining devices 35, which include airbags, seat-belt tensioners, and roll bars.

### Abstract

~~Provided is a~~A device for classifying at least one object with the aid of an environmental sensor system. The device classifies the at least one object on the basis of its velocity and acceleration, the device determining the velocity and the acceleration from a signal of the environmental sensor system.

~~(Figure 1)~~

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